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Brain's Appetite Regulator Disrupted in Obese Teens

AT A GLANCE

- **Obese teenagers have disrupted white matter integrity in several regions of the brain.**
- **The affected brain regions are associated with appetite, emotions, impulse control, and reward and pleasure in eating.**
- **Obesity among adolescents has more than quadrupled over the past three decades.**

CHICAGO – Researchers using advanced MRI to study obese adolescents found disrupted connectivity in the complex regions of the brain involved in regulating appetite, according to a new study presented today at the annual meeting of the Radiological Society of North America (RSNA).

According to the Centers for Disease Control and Prevention (CDC), obesity has more than quadrupled in adolescents over the past 30 years. It is estimated that more than one-third of children and adolescents in the U.S. are overweight or obese. Obesity in adolescence is associated with a number of health risks, including cardiovascular disease and diabetes.

The study at the University of Sao Paulo in Brazil included 59 obese adolescents between the ages of 11 and 18 and 61 healthy control adolescents matched for gender, age, socio-economical classification and education level. The adolescents were classified by the World Health Organization criterion for obesity. They had no other known chronic diseases or conditions. The study participants underwent diffusion tensor imaging (DTI) of the brain to evaluate white matter integrity.

DTI is a type of MRI exam that measures functional anisotropy (FA), the microscopic motion, or anisotropy, of water molecules within and surrounding the brain's white matter fibers. Low FA values indicate greater disruption within the white matter.

“DTI is a relatively new MRI technique not widely used in clinical diagnosis,” said study author Pamela Bertolazzi, a biomedical scientist and Ph.D. student in the neuroimaging laboratory at the University of Sao Paulo.

The results showed loss of white matter integrity in several brain regions in the obese patients. Compared to the healthy controls, the brains of the obese adolescents showed a decrease in FA

values in areas of the brain including the amygdala, hippocampus, thalamus, cingulate gyrus, fornix, insula, putamen, orbital gyrus and bilateral hypothalamus. Several of these regions are involved in appetite regulation, impulse control, emotions and reward and pleasure in eating.

“The data reveal a pattern of involvement among brain regions that are important in the control of appetite and emotions,” Bertolazzi said. “There was no region of higher FA in obese patients compared to the control group,” she added.

The researchers hope that these findings will offer new tools to combat this global public health crisis.

“Childhood obesity has increased 10 to 40 percent in the last 10 years in most countries,” Bertolazzi said. “If we are able to identify the brain changes associated with obesity, this DTI technique could be used to help prevent obesity and avoid the complications associated with the condition.”

Co-authors are Prof. Fabio Duran, Ph.D., Naomi Costa, Prof. Cristiane Kochi, Ph.D., Prof. Marilia Seelaender, Ph.D., Thaysa Neves, Ph.D., Elie Calfat, Ph.D., and Prof. Ricardo Riyoiti Uchida, Ph.D.

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Women Prefer Getting Mammograms Every Year

AT A GLANCE

- **In a recent survey, 71 percent of women said they prefer to undergo screening mammography every year instead of every two years.**
- **The USPSTF recommends screening every two years, beginning at age 50.**
- **The USPSTF recommendation is based in part on what it perceives as “harms” of additional testing and anxiety that may result from over-diagnosis and treatment.**

CHICAGO – Women prefer to get their mammograms every year, instead of every two years, according to a new study being presented next week at the annual meeting of the Radiological Society of North America (RSNA).

“Women understand that yearly mammograms have been shown to save lives and do not consider previously reported ‘harms’ to be as important as getting screened,” said study author Ghizlane Bouzghar, M.D., chief radiology resident at Einstein Medical Center in Philadelphia.

For years, the standard recommendation among most medical groups was that women at average risk of breast cancer undergo screening mammography annually beginning at age 40. However, in 2009, the U.S. Preventive Services Task Force (USPSTF) issued a controversial

recommendation that women at average risk be screened biennially, or every two years, beginning at age 50. This recommendation, reaffirmed in 2016, was based in part on the “harms” associated with screening mammography.

These “harms,” as defined by the USPSTF, include diagnosis and treatment of noninvasive and invasive breast cancers that would otherwise not have become a threat to a woman’s health and the unnecessary biopsies and associated anxieties resulting from false-positive results.

Others argue that while reducing over-diagnosis and false positives are a priority, the benefits of early detection far outweigh the negative factors associated with the perceived harms. Absent from the debate has been one notable opinion: that of the women being screened.

“The USPSTF associates annual screening mammography with ‘harm’ and recommends biennial screening mammography instead,” Dr. Bouzghar said. “However, there is no study to date that looked at women’s preference regarding annual versus biennial screening mammography, and whether women think that biennial screening causes less, equal or more anxiety.”

Dr. Bouzghar and colleagues at Einstein set out to determine whether women preferred annual or biennial screening and to investigate whether or not reported harms of mammography influenced this preference.

The research team surveyed 731 women (mean age 59) undergoing screening and diagnostic mammograms at Einstein from December 2016 to February 2017. Women were asked whether an abnormal mammogram or breast biopsy causes emotional harm, whether screening every two years was associated with less or more anxiety, and whether they preferred to have a screening mammogram every other year or every year.

Variables such as the patient's age, race, family and personal history of breast cancer, prior biopsies and abnormal mammograms, and underlying anxiety disorder were also included.

Of the women surveyed, 71 percent preferred getting screened every year. A family history of breast cancer and prior breast biopsy were the only two variables to have an additional positive influence on annual screening preference.

“Many women are much better educated about the value of screening mammography than they are given credit for,” Dr. Bouzghar said. “I also think that some of the USPSTF's concerns about the ‘harms’ were somewhat paternalistic, and in 2017 women are more empowered about many things, including their healthcare.”

Co-authors on the study are Debra S. Copit, M.D., and Justin R. Overcash, M.D.

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Fat Distribution in Women and Men Provides Clues to Heart Attack Risk

AT A GLANCE

- **Two new studies of overweight and obese adults identified new relationships between fat and cardiometabolic risk.**
- **In the first study, women with deep belly fat, as well as fat in their muscles and livers, were found to be at greater risk for cardiometabolic disease, such as heart disease, diabetes and stroke, compared to men.**
- **In the second study, young adults—and particularly women—with low muscle mass in relation to BMI were found to be at greater risk for cardiometabolic disease.**

CHICAGO – It's not the amount of fat in your body but where it's stored that may increase your risk for heart attack, stroke and diabetes, according to a new study presented today at the annual meeting of the Radiological Society of North America (RSNA). The study looked at the differences in fat distribution patterns among overweight and obese men and women and their associated cardiometabolic risk.

According to the National Center for Health Statistics, more than 70 percent of Americans are considered overweight or obese. Obesity puts individuals at risk for a variety of health problems, and is the second leading cause of preventable death in the U.S.

However, people of the same weight or body mass index (BMI) may have very different risk profiles, based on genetics, lifestyle and diet. In addition, body composition differs between men and women, with women having proportionately more fat and men having more muscle mass.

Fat distribution is an important determinant of cardiometabolic risk. Most people have heard the phrases “apple-shaped” and “pear-shaped.” These are common descriptors of human body shapes, based on where fat tends to be stored in the body. In apple-shaped bodies, fat is distributed largely around the midsection, while in pear-shaped bodies, fat is distributed lower around the hips and thighs. The type of fat stored also plays a role in cardiometabolic risk. One type of fat—ectopic fat—is particularly dangerous. It may be found in places such as the abdominal region, muscles, liver and other organs.

“We hypothesized that there are gender-based differences in body composition and ectopic fat depots and that these could be associated with gender-specific risk profiles for diseases like diabetes, heart disease and stroke,” said lead author Miriam A. Bredella, M.D., radiologist at Massachusetts General Hospital and associate professor of radiology at Harvard Medical School in Boston.

For the study, Dr. Bredella and colleagues recruited 200 young (mean age 37), overweight and obese individuals who were otherwise healthy. Of the 200, 109 were women and 91 were men. Women and men were of a similar age and BMI.

After fasting overnight, the study participants underwent dual-energy x-ray absorptiometry (DXA) and CT scans to determine body composition, as well as magnetic resonance spectroscopy (MRS) for fat quantification and analysis.

The results showed that the women had a higher percentage of fat and more subcutaneous (below-the-skin) fat but lower lean mass, compared to men. However, men had more visceral adipose tissue (VAT), or ectopic fat depots located in the abdomen around the internal organs (commonly known as a “beer belly”), and more ectopic fat in the muscles and liver.

“Obese men have relatively higher visceral fat, fat within muscle cells and liver fat, which are all risk factors for cardiometabolic disease, compared to women with the same BMI,” Dr Bredella said. “However, men have higher muscle and lean mass, which are protective for cardiometabolic health. Women have a higher relative amount of total body fat and higher superficial thigh fat, which is protective for cardiometabolic health.”

Compared to women, men had higher measures of cardiometabolic risk overall, but ectopic fat was not significantly associated with cardiometabolic risk in men. Ectopic fat in women, however, was strongly associated with cardiometabolic risk measures.

“The detrimental fat depots deep in the belly, muscles and liver are more damaging for cardiometabolic health in women compared to men,” Dr. Bredella said.

In a related study presented by Dr. Bredella today at RSNA 2017, the researchers looked at the relationship between sarcopenic obesity—or the loss of skeletal lean muscle mass in the presence of obesity—and its relationship to cardiometabolic risk.

Many factors can lead to sarcopenic obesity in young adults, particularly obesity and lack of exercise.

“But there are also hormonal abnormalities,” Dr. Bredella said, “such as low growth hormone secretion in individuals with abdominal obesity. Growth hormone helps to build muscle mass. Nutrition also plays an important role, and too little intake of protein can lead to muscle loss.”

The researchers studied 188 young, overweight and obese adults who were otherwise healthy. Participants underwent DXA and CT scans and various metabolic tests. Results showed that having a lower lean muscle mass to BMI ratio was associated with cardiometabolic risk, and these effects were stronger in women than in men.

“Sarcopenic obesity may be an under-appreciated mechanism linking obesity to cardiometabolic disease,” Dr. Bredella said. “That stresses the importance of building up muscle mass in the setting of obesity.”

Co-authors on both studies are Melanie Schorr, M.D., Laura Dichtel, M.D., Martin Torriani, M.D., and Karen K. Miller, M.D.

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Hip Steroid Injections Associated with Bone Changes

AT A GLANCE

- **Individuals with osteoarthritis who received steroid injections in the hip showed a higher incidence of changes to bone, including bone death and collapse, compared to two control groups.**
- **Steroid injections are commonly used to treat joint pain and inflammation.**
- **Though these findings raise some concerns, they should not deter patients from getting needed injections.**

CHICAGO – Osteoarthritis patients who received a steroid injection in the hip had a significantly greater incidence of bone death and collapse compared with control groups, according to new research presented today at the annual meeting of the Radiological Society of North America (RSNA).

Receiving an injection of a steroid and anesthetic is a common treatment for patients who are experiencing pain and inflammation in a joint, such as the hip, knee or shoulder.

“Changes due to osteoarthritis, such as narrowing in the space between joints and the development of bony proliferations, typically develop slowly over time,” said Connie Y. Chang, M.D., radiologist at Massachusetts

General Hospital and assistant professor of radiology at Harvard Medical School in Boston. “When reading follow-up radiographs of patients who had received a hip injection, we noticed changes had developed rapidly in some patients.”

To determine whether arthritis worsened in patients following a hip steroid/anesthetic injection, Chang and a team of radiologists specializing in musculoskeletal diagnostic imaging and intervention, including hip injections, conducted a study involving 102 patients (age range 19-92, including 62 women) who received X-ray images of the treated hip at the time of the injection and during a follow-up three to nine months later.

Two musculoskeletal radiologists independently reviewed the X-ray images of the patients who received the injections and those of two control groups matched to demographics and follow-up imaging duration. The control groups consisted of 102 patients who had hip X-rays without steroid/anesthetic injection and 44 patients who underwent imaging and a steroid/anesthetic injection in the shoulder.

The radiologists reported new osteonecrosis in 22-24 percent of hip injection patients, compared to 5-9 percent in the hip control group and 5 percent in the shoulder injection control group. They observed bone collapse in the head of the femur bone, located at the top of the femur at the articulation with the pelvic bone, in 15-17 percent of hip injection patients, versus 4 percent of hip control patients and 2 percent of shoulder control patients.

Hip injection patients also showed increased imaging findings of osteoarthritis compared to the control groups, but the differences were not statistically significant.

Dr. Chang noted that patients receiving hip injections have symptoms of hip pain severe enough to require the injection and may be prone to faster progression of bony changes compared to the control groups. These considerations may be important as some orthopedists are requesting higher steroid doses and injections in younger patients.

“We need to look at what’s going on with the steroid/anesthetic injectate and osteoarthritis patients to determine what’s causing the changes that occur in some patients,” Dr. Chang said. “However, we don’t want to deter patients from getting an injection. These results are enough to warrant an investigation, but not enough to cancel a procedure.”

Co-authors are F. Joseph Simeone, M.D., Joao Rafael T. Vicentini, M.D., and Susan V. Kattapuram, M.D.

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New Studies Show Brain Impact of Youth Football

AT A GLANCE

- **Two new studies revealed changes in the default mode network in the brains of young football players.**
- **One study used machine learning to predict which players had high- and low-impact exposure based on fMRI results.**
- **A second study showed DMN changes may be dependent on a player's previous concussion history.**

CHICAGO – School-age football players with a history of concussion and high impact exposure undergo brain changes after one season of play, according to two new studies conducted at UT Southwestern Medical Center in Dallas and Wake Forest University in Winston-Salem and presented today at the annual meeting of the Radiological Society of North America (RSNA).

Both studies analyzed the default mode network (DMN), a network of brain regions that is active during wakeful rest. Changes in the DMN are observed in patients with mental disorders. Decreased connectivity within the network is also associated with traumatic brain injury.

“The DMN exists in the deep gray matter areas of the brain,” explained Elizabeth M. Davenport, Ph.D., a postdoctoral researcher in the Advanced Neuroscience Imaging Research (ANSIR) lab at

UT Southwestern’s O’Donnell Brain Institute. “It includes structures that activate when we are awake and engaging in introspection or processing emotions, which are activities that are important for brain health.”

In the first study, researchers studied youth football players without history of concussion to identify the effect of repeated subconcussive impacts on the DMN.

“Over a season of football, players are exposed to numerous head impacts. The vast majority of these do not result in concussion,” said Gowtham Krishnan Murugesan, a Ph.D. student in biomedical engineering and member of the ANSIR lab. “This work adds to a growing body of literature indicating that subconcussive head impacts can have an effect on the brain. This is a highly understudied area at the youth and high school level.”

For the study, 26 youth football players (ages 9-13) were outfitted with the Head Impact Telemetry System (HITS) for an entire football season. HITS helmets are lined with accelerometers or sensors that measure the magnitude, location and direction of impacts to the head. Impact data from the helmets were used to calculate a risk of concussion exposure for each player.

Players were equally divided into high and low concussion exposure groups. Players with a history of concussion were excluded. A third group of 13 non-contact sport controls was established. Pre- and post-season resting functional MRI (fMRI) scans were performed on all players and controls, and connectivity within the DMN sub-components was analyzed.

The researchers used machine learning to analyze the fMRI data. Machine learning is a type of artificial intelligence that allows computers to perform analyses based on existing relationships of data.

“Machine learning has a lot to add to our research because it gives us a fresh perspective and an ability to analyze the complex relationships within the data,” said Murugesan. “Our results suggest an increasing functional change in the brain with increasing head impact exposure.”

Five machine learning classification algorithms were used to predict whether players were in the high-exposure, low-exposure or non-contact groups based on the fMRI results. The algorithm discriminated between high-impact exposure and non-contact with 82 percent accuracy, and low-impact exposure and non-contact with 70 percent accuracy. The results suggest an increasing functional change with increasing head-impact exposure.

“The brains of these youth and adolescent athletes are undergoing rapid maturation in this age range. This study demonstrates that playing a season of contact sports at the youth level can produce neuroimaging brain changes, particularly for the DMN,” Murugesan said.

In the second study, 20 high school football players (median age 16.9) wore helmets outfitted with HITS for a season. Of the 20 players, five had experienced at least one concussion, and 15 had no history of concussion.

Before and following the season, the players underwent an eight-minute magnetoencephalography (MEG) scan, which records and analyzes the magnetic fields produced by brain activity. Researchers then analyzed the MEG power associated with the eight brain regions of the DMN.

Post-season, the five players with a history of concussion had significantly lower connectivity between DMN regions. Players with no history of concussion had, on average, an increase in DMN connectivity.

The results demonstrate that concussions from previous years can influence the changes occurring in the brain during the current season, suggesting that there are longitudinal effects of concussion that affect brain function.

“The brain’s default mode network changes differently as a result of previous concussion,” Dr. Davenport said. “Previous concussion seems to prime the brain for additional changes. Concussion history may be affecting the brain’s ability to compensate for subconcussive impacts.”

Both researchers said larger data sets, longitudinal studies that follow young football players and research that combines both MEG and fMRI are needed to better understand the complex factors involved in concussions.

Murugesan co-authors are Afarin Famili, Elizabeth M. Davenport, Ph.D., Ben Wagner, B.M., Christopher T. Whitlow, M.D., Ph.D., Joel Stitzel, Jillian Urban, Joseph A. Maldjian, M.D., and Albert Montillo, Ph.D. Davenport co-authors are Jillian Urban, Ben Wagner, B.M., Mark A. Espeland, Ph.D., Alexander K. Powers, M.D., Christopher T. Whitlow, M.D., Ph.D., Joel Stitzel, and Joseph A. Maldjian, M.D. This work is part of several NIH-funded studies of youth and high school football, with additional funding from the Childress Institute for Pediatric Trauma. Data collection performed by researchers at Wake Forest University, and data analysis done by researchers at UT Southwestern.

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Emergency Radiologists See Inner Toll of Opioid Use Disorders

AT A GLANCE

- **There is a high prevalence of emergency radiology patients with complications from opioid abuse.**
- **Patients with positive imaging findings and history of opioid prescriptions have a higher mortality rate.**
- **History of opioid prescriptions was significantly higher in women than in men.**

CHICAGO – Emergency radiologists are seeing a high prevalence of patients with complications related to opioid use disorders, according to results from a 12-year study presented today at the annual meeting of the Radiological Society of North America (RSNA). Researchers said the findings underscore the need for radiologists to play a role in the care continuum for these patients.

Substance use disorders of highly addictive opioids like heroin, fentanyl and oxycodone continue to skyrocket in the U.S. Intravenous opioid use disorders are a major contributor to the drug overdoses that are the leading cause of injury death in the United States, according to the Department of Health and Human Services. Patients

prescribed opioid medications for pain management of a medical condition often develop dependence, and many go from crushing and injecting pills to injecting heroin as a less expensive way to deal with their disease, said senior study author Efren J. Flores, M.D., emergency radiologist at Massachusetts General Hospital in Boston.

“We’ve seen a dramatic increase in the past year of patients coming into the Emergency Department with complications related to substance use disorders,” he said. “The patient population is underserved. By the time we see them, they have more advanced complications because they’re hesitant to ask for help due to social stigmas.”

For the study, Dr. Flores and colleagues looked at the prevalence and type of complications related to substance use disorders in patients arriving at Emergency Radiology. The study group included 1,031 patients imaged from 2005 to 2016 for substance use-related complications. Of all the patients, 66 percent were men, 78 percent were white and the mean age was 36 years.

The results showed a high prevalence of complications among the patients, including symptoms related to injections, respiratory issues and back pain.

“Complications were most frequently related to skin and soft tissue infections caused by the use of non-sterile needles,” Dr Flores said. “In some cases, we found septic emboli in the lung or brain. As these patients start having to access larger veins, they become more prone to these types of infections.”

There were 1,673 imaging exams performed, including 779 X-rays, 544 CTs, 292 MRIs and 58 ultrasounds. Imaging results often provided critical information, such as when physicians changed the management plan for a patient with a substance-abuse-related lumbar spine infection after CT scans showed the involved nerves.

History of opioid prescriptions before the first imaging exam was present in 310 (30 percent) cases with a mean of 10 prescriptions per patient. History of opioid prescriptions was significantly higher in women (36 percent, 128/352), than men (27 percent, 182/679). Mean time from opioid prescription to first imaging exam was 51 months – significantly shorter in men (45 months) than women (51 months).

Overall, 121 of the 1,031 patients, or 11.7 percent, died before the end of the study period. The mortality rate was 14 percent for patients with a positive imaging diagnosis of substance-abuse-related complications – significantly higher than the 10 percent rate for patients with no such history. Five-year mortality rates were also higher in patients with prior opioid prescriptions and with imaging complications.

The prevalence of substance use disorder in patients presenting to Emergency Radiology provides radiologists a unique opportunity to “look beyond the reading room, and see other ways we can help,” Dr. Flores said. For instance, radiologists can encourage patients to use sterile needles, inform them about needle exchange programs and advise them to use alcohol at the injection site to avoid infections. Radiologists can also help steer patients into programs or connect them with recovery coaches, both in the hospital and community, to help them with their illness.

“Radiology is central to patient care in the Emergency Department setting,” Dr. Flores said. “We need to be actively advocating for these patients and giving them an opportunity to take steps into recovery.”

Co-authors are Renata R. Almeida, M.D., Mohammad Mansouri, M.D., M.P.H., Ajay K. Singh, M.D., and Michael H. Lev, M.D.

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Radiology Offers Clues in Cases of Domestic Abuse and Sexual Assault

AT A GLANCE

- **Medical images can help identify cases of intimate partner violence and sexual assault.**
- **Researchers found common patterns of injury among victims of intimate partner violence.**
- **Radiologists have access to prior imaging records that can reveal a history of abuse.**

CHICAGO – Radiologic signs of injury could help identify victims of intimate partner violence, according to a study presented today at the annual meeting of the Radiological Society of North America (RSNA).

“Radiologists must be aware that intimate partner abuse is a common public health problem,” said study author Elizabeth George, M.D., a radiology resident at Brigham and Women’s Hospital in Boston. “It affects one in four women in the United States. So many of the patients we encounter may have this unfortunate story.”

Medical images sometimes offer early clues that abuse is taking place. In fact, the case that inspired the study’s

principal investigator, Bharti Khurana, M.D., emergency radiology fellowship program director at Brigham and Women’s Hospital., involved a young woman who arrived at the Emergency Department with an acute nasal bone fracture superimposed on an old, healed fracture. While going through prior medical images of the patient on the hospital’s picture archiving and communication system, or PACS, Dr. Khurana identified a recent wrist fracture. This pattern of recurrent injury made her voice her suspicion of intimate partner violence, a finding the referring physician initially had not suspected.

“This also led us to connect with some of our Emergency Department staff physicians and colleagues who were already working on the clinical and social aspects of this issue,” Dr. Khurana said. “We went on to design this research study to objectively assess the clinical and radiologic findings in this population.”

The study, which reviewed electronic medical records from patients referred to domestic abuse and sexual assault programs from January to October 2016, found characteristic injuries among the patients.

“On the radiologic front, we identified common patterns of injury such as soft tissue injuries and extremity fractures, which often involved the distal upper extremities, suggesting injury from defensive attempts,” Dr. George said. “Other commonly seen injuries were facial fractures, which represent an easily accessible area for inflicting trauma. These injury patterns could alert the radiologists to potential intimate partner violence.”

A majority of the 87 intimate partner violence victims were female (95 percent) and African-American (40 percent), with a mean age of 34.7 years. A total of 665 radiology exams were performed in this population over five years. The most commonly performed exam was chest X-ray, followed by obstetric ultrasound and musculoskeletal X-rays.

The 35 sexual assault victims were younger (mean age 27.3 years), majority female (91 percent), and African-American (46 percent). A total of 109 radiology exams were performed in this population over five years. The most commonly performed exam was chest X-ray, followed by head CT, pelvic ultrasound and musculoskeletal X-rays. There were fewer traumatic injuries in this population.

The intimate partner violence victims were more likely to be homeless, while the sexual assault victims were more likely to suffer from illicit drug abuse.

“Our findings point toward the complex nature of these social situations and the need for a targeted intervention program not only to identify but also intervene in the various aspects of care of these patients,” Dr. Khurana said.

Along with providing information on presenting injuries, radiologists have access to a wealth of information through PACS that can show prior fractures linked to abuse. Old, healed fractures look distinct from acute fractures, Dr. Khurana said, and may be evident in the form of bone remodeling, deformity or focal bone thickening.

“In the emergency room setting, the priority is to identify acute pathologies,” she said. “As a result, old fractures or fracture-related deformities may not be given sufficient importance. But the presence of old and acute fractures may be pivotal in making the diagnosis of intimate partner violence.”

Findings suggestive of abuse should trigger a conversation between the radiologist and the referring physician, the researchers noted. Additional communications with the patient would involve a multidisciplinary team with the experience and resources to address the issue.

“At our institution, we are fortunate to work in a system that has strongly implemented screening for intimate partner violence, and there exists a multidisciplinary team of physicians, nurse practitioners and social workers facilitating comprehensive care,” Dr. George said. “We are hopeful that the results of our study will increase awareness and pave the way for more research, as well as resources with multidisciplinary teams devoted to the care of this vulnerable population.”

Co-authors are Catherine Phillips, M.D., Nandish Shah, M.D., Annie Lewis-O’Connor, Ph.D., M.P.H., and Hanni M. Stoklosa, M.D., M.P.H.

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Weight Loss Through Exercise Alone Does Not Protect Knees

AT A GLANCE

- **Researchers investigated the association between different regimens of weight loss and the progression of knee cartilage degeneration in 760 overweight and obese patients.**
- **Individuals who lost weight through diet alone or diet and exercise slowed the progression of cartilage degeneration in the knee.**
- **Individuals who lost the same amount of weight through exercise alone did not slow the progression of cartilage degeneration.**

CHICAGO – Obese people who lose a substantial amount of weight can significantly slow down the degeneration of their knee cartilage, but only if they lose weight through diet and exercise or diet alone, according to a new MRI study presented today at the annual meeting of the Radiological Society of North America (RSNA).

Obesity is a major risk factor for osteoarthritis, a degenerative joint disease that affects more than a third of adults over the age of 60, according to the Centers for Disease Control and Prevention. The knee joint is a common site of osteoarthritis, and in many people the condition progresses until total knee replacement becomes necessary.

“Once cartilage is lost in osteoarthritis, the disease cannot be reversed,” said the study’s lead author, Alexandra Gersing, M.D., from the Department of Radiology and Biomedical Imaging at the University of California, San Francisco.

Since cartilage loss cannot be reversed, it is important for people at risk of osteoarthritis or with early signs of the disease to slow the degeneration of cartilage. Weight loss has been shown to slow down cartilage degeneration in overweight and obese individuals, but it was unclear if the method used to lose weight made a difference.

Dr. Gersing and colleagues investigated cartilage degeneration and joint abnormalities over the course of 96 months in overweight and obese individuals who maintained stable weight and who lost weight via differing regimens.

The researchers studied 760 men and women with a body mass index of greater than 25 from the Osteoarthritis Initiative, a nationwide research study focused on the prevention and treatment of knee osteoarthritis. The patients either had mild to moderate osteoarthritis or risk factors for the disease. Patients were divided into a group of 380 patients who lost weight, and a control group of 380 patients who lost no weight. The weight-loss group was further segmented by weight loss method: diet and exercise, diet alone and exercise alone. The researchers used MRI to quantify knee osteoarthritis at the beginning of the study, at 48 months and at 96 months.

Cartilage degeneration was significantly lower in the weight loss group, compared to the control group over the 96 months. However, this finding was only present among the patients who lost weight through diet and exercise or diet alone. Although patients who only exercised lost as much weight as patients who dieted alone or dieted and exercised, weight loss through exercise alone showed no significant difference in cartilage degeneration, compared to the group who lost no weight.

“These results add to the hypothesis that solely exercise as a regimen in order to lose weight in overweight and obese adults may not be as beneficial to the knee joint as weight loss regimens involving diet,” Dr. Gersing said.

Co-authors on the study are Gabby B. Joseph, Ph.D., Benedikt J. Schwaiger, M.D., Charles E. McCulloch, Ph.D., Michael C. Nevitt, Ph.D., and Thomas M. Link, M.D., Ph.D.

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3-D-Printed Prosthetic Implants Could Improve Treatment for Hearing Loss

AT A GLANCE

- **Researchers created 3-D printed custom-designed prosthetic replacements for damaged parts of the middle ear.**
- **Surgical reconstruction, which generally involves tailoring a prosthesis for each patient in the operating room, has a high failure rate.**
- **A custom-designed prosthesis with a more exact fit could have a higher rate of success.**

CHICAGO – Researchers using CT scans and 3-D printing have created accurate, custom-designed prosthetic replacements for damaged parts of the middle ear, according to a study being presented today at the annual meeting of the Radiological Society of North America (RSNA). The technique has the potential to improve a surgical procedure that often fails because of incorrectly sized prosthetic implants, researchers said.

Hearing works partly through the transmission of vibrations from the ear drum to the cochlea, the sensory organ of hearing, via three tiny bones in the middle ear known as ossicles. Ossicular conductive hearing loss occurs when the ossicles are damaged, such as from trauma or infection.

Conductive hearing loss can be treated through surgical reconstruction using prostheses made from stainless steel struts and ceramic cups. The surgery, which generally involves tailoring

a prosthesis for each patient in the operating room, is plagued by high failure rates.

“The ossicles are very small structures, and one reason the surgery has a high failure rate is thought to be due to incorrect sizing of the prostheses,” said study author Jeffrey D. Hirsch, M.D., assistant professor of radiology at the University of Maryland School of Medicine (UMSOM) in Baltimore. “If you could custom-design a prosthesis with a more exact fit, then the procedure should have a higher rate of success.”

Dr. Hirsch and colleagues studied 3-D printing as a way to create customized prostheses for patients with conductive hearing loss. The technology has been used successfully to solve a number of other medical prosthesis problems, including in the areas of joint replacement and facial reconstruction surgery.

The researchers removed the middle linking bone in the ossicular chain from three human cadavers and imaged the structures with CT. They employed an inexpensive 3-D printer to create prostheses to restore continuity for each of the middle ears. The prostheses were made from a resin that hardens when exposed to ultraviolet laser light. Each of the prostheses had unique measurements.

Four surgeons then performed insertion of each prosthesis into each middle ear, blinded to the bone from and for which each was designed. The researchers then asked the surgeons to match each prosthesis to its correct source. All four surgeons were able to correctly match the prosthesis model to its intended temporal bone — the bone containing the middle and inner parts of the ear. The chances of this occurring randomly are 1 in 1,296, according to Dr. Hirsch.

“This study highlights the core strength of 3-D printing — the ability to very accurately reproduce anatomic relationships in space to a sub-millimeter level,” Dr. Hirsch said. “With these models, it’s almost a snap fit.”

The results suggest that commercially available CT scanners can detect significant anatomic differences in normal human middle ear ossicles, and that these differences can be accurately represented with current 3-D printing technology. More significantly, surgeons are able to detect these differences, which should not only increase the likelihood of a proper fit, but also decrease surgical time, according to Dr. Hirsch.

The next step in the research, Dr. Hirsch said, is to create prostheses out of biocompatible materials. The researchers are also looking at a different approach that would combine the 3-D-printed prostheses with stem cells.

“Instead of making the middle ear prosthesis solid, you could perforate it to be a lattice that allows stem cells to grow onto it,” Dr. Hirsch said. “The stem cells would mature into bone and become a permanent fix for patients with hearing loss.”

Co-authors are David Eisenman, M.D., and Richard Vincent, M.D.

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Embargoed for release on Wednesday, Nov. 29, 2017, at 5:00 a.m. ET

CT Shows Enlarged Aortas in Former Pro Football Players

AT A GLANCE

- **Former pro football players are more likely to have enlarged aortas.**
- **Enlarged aortas increase the risk of life-threatening aneurysms.**
- **CT results showed enlarged aortas in nearly 30 percent of football players studied, compared to 8.6 percent of non-players.**

CHICAGO – Former National Football League (NFL) players are more likely to have enlarged aortas, a condition that may put them at higher risk of aneurysms, according to a study being presented today at the annual meeting of the Radiological Society of North America (RSNA).

The aorta, the largest artery in the body, carries blood from the left ventricle, the heart's main pumping chamber, to the rest of the body. The short section that rises from the left ventricle and supplies the coronary arteries with blood is called the ascending aorta. Enlargement, or dilation, of the ascending aorta can increase the chances of a life-threatening aneurysm. Risk factors for dilation include high

blood pressure, smoking and connective tissue disorders.

“Patients whose ascending aortas are more than 4 centimeters in diameter are generally considered to have dilation, which can progress over time and potentially weaken the wall of the aorta,” said study author Christopher Maroules, M.D., formerly of the University of Texas Southwestern Medical Center in Dallas and current chief of cardiothoracic imaging at the Naval Medical Center in Portsmouth, Va.

For the new study, Dr. Maroules and colleagues evaluated whether past participation in the NFL is associated with increased prevalence of ascending aortic dilation. The research arose from observations made by the study's principal investigator Dermot Phelan, M.D., Ph.D., from Cleveland Clinic, who has worked closely over the years with the NFL, studying the cardiovascular health of retired players.

The researchers compared 206 former NFL athletes with 759 men from the Dallas Heart Study who were older than age 40 with a body mass index greater than 20. They obtained imaging data using cardiac gated non-contrast CT, a technique that allowed them to “freeze” the motion of the heart by synchronizing the CT to the electrocardiogram. They also obtained coronary artery calcium scores, a measure of atherosclerotic plaque.

Compared to the control group, former NFL athletes had significantly larger ascending aortic diameters. Almost 30 percent of the former NFL players had an aorta wider than 4 centimeters, compared with only 8.6 percent of the non-players. Even after adjusting for age, body mass and cardiac risk factors, former NFL players were still twice as likely as the control group to have an aorta wider than 4 centimeters.

The coronary artery calcium scores were similar in both groups.

“In former NFL athletes, there was a significantly higher proportion of aortic dilation compared to our control group,” said Dr. Maroules. “This process is likely not associated with atherosclerosis cardiovascular disease, because when we compared coronary calcium we found no significant difference between the two groups.”

The results suggest that some type of remodeling process occurs in the aorta of athletes who engage in repeated strenuous exercise, according to Dr. Maroules.

“It remains to be seen if this remodeling sets athletes up for problems later in life,” he said. “We’re just scratching the surface of this intriguing field, and imaging can play an important role in it.”

Other co-authors are David Carruthers, M.D., Parag Joshi, M.D., Colby Ayers, M.S., James Gentry, M.D., Rory Hachamoitch, M.D., and Andrew Lincoln, M.D.

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Study Finds No Evidence that Gadolinium Causes Neurologic Harm

AT A GLANCE

- **There is no evidence that gadolinium retained in the brain after MRI is associated with adverse neurological outcomes.**
- **The researchers analyzed data from the world's largest prospective study on aging.**
- **Gadolinium-based contrast agents are used in 40-50 percent of MRI exams.**

CHICAGO – There is no evidence that accumulation in the brain of the element gadolinium speeds cognitive decline, according to a new study presented today at the annual meeting of the Radiological Society of North America (RSNA).

Gadolinium-based contrast media were introduced in 1988 as a means of enhancing MRI images and are commonly used today. The contrast agent is injected into the patient's bloodstream and eliminated from the body through the kidneys.

“It's estimated that approximately 400 million doses of gadolinium have been administered since 1988,” said the

study's lead author, Robert J. McDonald, M.D., Ph.D., neuroradiologist at the Mayo Clinic in Rochester, Minn. “Gadolinium contrast material is used in 40 to 50 percent of MRI scans performed today.”

Scientists previously believed gadolinium contrast material could not cross the blood-brain barrier, the semipermeable membrane that selectively filters materials from the bloodstream from entering extracellular fluid in the brain and central nervous system. However, recent studies, including one from Dr. McDonald and colleagues, found that traces of gadolinium could be retained in the brain for years after MRI.

On September 8, 2017, the FDA recommended adding a warning to labels about gadolinium retention in various organs, including the brain, for gadolinium-based contrast agents used during MRI. The FDA highlighted several specific patient populations at greater risk, including children and pregnant women.

Still, very little is known about the health effects, if any, of gadolinium that is retained in the brain.

For this study, Dr. McDonald and colleagues set out to identify the neurotoxic potential of intracranial gadolinium deposition following intravenous administration of gadolinium-based contrast agents during MRI.

The researchers used the Mayo Clinic Study of Aging (MCSA), the world’s largest prospective population-based cohort on aging, to study the effects of gadolinium exposure on neurologic and neurocognitive function.

All MCSA participants underwent extensive neurologic evaluation and neuropsychological testing at baseline and 15-month follow-up intervals. Neurologic and neurocognitive scores were compared using standard methods between MCSA patients with no history of prior gadolinium exposure and those who underwent prior MRI with gadolinium-based contrast agents. Progression from normal cognitive status to mild cognitive impairment and dementia was assessed using multistate Markov model analysis.

The study included 4,261 cognitively normal men and women, between the ages of 50 and 90 with a mean age of 72. Mean length of study participation was 3.7 years. Of the 4,261 participants, 1,092 (25.6 percent) had received one or more doses of gadolinium-based contrast agents, with at least one participant receiving as many as 28 prior doses. Median time since first gadolinium exposure was 5.6 years.

After adjusting for age, sex, education level, baseline neurocognitive performance, and other factors, gadolinium exposure was not a significant predictor of cognitive decline, dementia, diminished neuropsychological performance or diminished motor performance. No dose-related effects were observed among these metrics. Gadolinium exposure was not an independent risk factor in the rate of cognitive decline from normal cognitive status to dementia in this study group.

“Right now there is concern over the safety of gadolinium-based contrast agents, particularly relating to gadolinium retention in the brain and other tissues,” Dr. McDonald said. “This study provides useful data that at the reasonable doses 95 percent of the population is likely to receive in their lifetime, there is no evidence at this point that gadolinium retention in the brain is associated with adverse clinical outcomes.”

Co-authors are Jennifer S. McDonald, Ph.D., Terry Therneau, Ph.D., Laurence J. Eckel, M.D., David F. Kallmes, M.D., Rickey Carter, Ph.D., Clifford R. Jack Jr., M.D., and Ronald C. Petersen, M.D., Ph.D.

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Migraines Linked to High Sodium Levels in Cerebrospinal Fluid

AT A GLANCE

- **Individuals who get migraine headaches may have higher concentrations of sodium in their cerebrospinal fluid.**
- **This is the first study to use sodium MRI to study migraines.**
- **Eighteen percent of women and 6 percent of men are affected by migraines.**

CHICAGO – Migraine sufferers have significantly higher sodium concentrations in their cerebrospinal fluid than people without the condition, according to the first study to use a technique called sodium MRI to look at migraine patients. The findings were presented today at the annual meeting of the Radiological Society of North America (RSNA).

Migraine, a type of headache characterized by severe head pain, and sometimes nausea and vomiting, is one of the most common headache disorders, affecting about 18 percent of women and 6 percent of men. Some migraines are accompanied by vision changes or odd sensations in the body known as auras. Diagnosis is challenging, as the characteristics of migraines and the types of attacks vary widely among patients. Consequently, many migraine

patients are undiagnosed and untreated. Other patients, in contrast, are treated with medications for migraines even though they suffer from a different type of headache, such as the more common tension variety.

“It would be helpful to have a diagnostic tool supporting or even diagnosing migraine and differentiating migraine from all other types of headaches,” said study author Melissa Meyer, M.D., radiology resident at the Institute of Clinical Radiology and Nuclear Medicine, University Hospital Mannheim and Heidelberg University in Heidelberg, Germany.

Dr. Meyer and colleagues explored a magnetic resonance technique called cerebral sodium MRI as a possible means to help in the diagnosis and understanding of migraines. While MRI most often relies on protons to generate an image, sodium can be visualized as well. Research has shown that sodium plays an important role in brain chemistry.

The researchers recruited 12 women, mean age 34, who had been clinically evaluated for migraine. The women filled out a questionnaire regarding the length, intensity and frequency of their migraine attacks and accompanying auras. The researchers also brought in 12 healthy women of similar ages to serve as a control group. Both groups underwent cerebral sodium MRI. Sodium concentrations of migraine patients and healthy controls were compared and statistically analyzed.

The researchers found no statistical differences between the two groups for sodium concentrations in the gray and white matter, brain stem and cerebellum. However, significant differences emerged when the researchers looked at sodium concentrations in the cerebrospinal fluid, the fluid that surrounds the brain and spinal cord, providing a cushion for the brain while also helping to ensure chemical stability for proper brain function.

Overall, sodium concentrations were significantly higher in the brain’s cerebrospinal fluid in migraine patients than in the healthy control group.

“These findings might facilitate the challenging diagnosis of a migraine,” Dr. Meyer said.

The researchers hope to learn more about the connection between migraines and sodium in future studies.

“As this was an exploratory study, we plan to examine more patients, preferably during or shortly after a migraine attack, for further validation,” Dr. Meyer said.

Co-authors are Alexander Schmidt, Justus Benrath, Simon Konstandin, Ph.D., Lothar R. Schad, Ph.D., Stefan O. Schoenberg, M.D., Ph.D., and Stefan Haneder, M.D.

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Minimally Invasive Treatment Provides Relief from Back Pain

AT A GLANCE

- **A minimally invasive treatment relieves low back pain in most patients in a single 10-minute session.**
- **After treatment, patients can resume normal activities within a day.**
- **Low back pain affects more than 80 percent of the population at some point.**

CHICAGO – The majority of patients were pain free after receiving a new image-guided pulsed radiofrequency treatment for low back pain and sciatica, according to a study presented today at the annual meeting of the Radiological Society of North America (RSNA).

Low back pain is an extremely common problem that affects at least 80 percent of the population at some point in their lifetime. It is the most common cause of job-related disability. Low back pain affects men and women equally.

Most back pain is short-term, but about 20 percent of people affected by acute low back pain go on to develop chronic low back pain lasting a year or more. A compressed and herniated disk, in which the rubbery cushion between vertebrae impinges on and irritates nearby nerves, is a major cause of low back pain that can radiate to the legs.

“The nerve root is a sensitive structure that when pinched becomes inflamed and causes pain,” said lead investigator Alessandro Napoli M.D., Ph.D., an interventional radiologist at Sapienza University of Rome. “The body reacts with muscle constriction, which decreases the distance between vertebrae, and a vicious cycle is created.”

The single-center prospective study included 80 patients experiencing at least three months of low back pain due to a herniated disk that had not responded to conservative treatments including exercise and medication.

The patients underwent a minimally invasive interventional radiology procedure in which, with the help of CT imaging, a needle is guided to the location of the bulging disc and nerve root. A probe is then inserted through the needle tip and delivers pulsed radiofrequency energy to the area over a 10-minute period. Even without touching the disc, the pulsation serves to resolve the herniation.

“The probe delivers a gentle electrical energy, so there’s no thermal damage,” Dr. Napoli said. “The results have been extraordinary. Patients have been relieved of pain and resumed their normal activities within a day.”

Of the 80 patients treated, 81 percent were pain free one year after a single 10-minute treatment session. Six patients required a second pulsed radiofrequency session. Ninety percent of the patients were able to avoid surgical treatment.

“Following this treatment, inflammation and pain go away. With relaxation of the muscles, the distance between the vertebrae returns,” Dr. Napoli explained.

Dr. Napoli said no patients experienced side effects after receiving the minimally invasive outpatient treatment.

“There’s a big gap between conservative treatments for disc compression and herniation and surgical repair, which can lead to infection, bleeding and a long recovery period,” Dr. Napoli said. “Evolving technologies like this image-guided treatment may help a substantial number of patients avoid surgery.”

Co-authors are Roberto Scipione, M.D., Hans Peter Erasmus, M.D., Cristina Marrocchio, M.D., Susan Dababou, M.D., and Carlo Catalano, M.D.

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Smartphone Addiction Creates Imbalance in Brain

AT A GLANCE

- **Smartphone and internet addiction increases the levels of a neurotransmitter called GABA in one region of the brain.**
- **GABA is an “inhibitory” neurotransmitter that regulates various brain functions, including anxiety.**
- **GABA ratios significantly correlated to clinical scales of internet and smartphone addictions, depression and anxiety.**

CHICAGO – Researchers have found an imbalance in the brain chemistry of young people addicted to smartphones and the internet, according to a study presented today at the annual meeting of the Radiological Society of North America (RSNA).

According to a recent Pew Research Center study, 46 percent of Americans say they could not live without their smartphones. While this sentiment is clearly hyperbole, more and more people are becoming increasingly dependent on smartphones and other portable electronic devices for news, information, games, and even the occasional phone call.

Along with a growing concern that young people, in particular, may be spending too much time staring into

their phones instead of interacting with others, come questions as to the immediate effects on the brain and the possible long-term consequences of such habits.

Hyung Suk Seo, M.D., professor of neuroradiology at Korea University in Seoul, South Korea, and colleagues used magnetic resonance spectroscopy (MRS) to gain unique insight into the brains of smartphone- and internet-addicted teenagers. MRS is a type of MRI that measures the brain’s chemical composition.

The study involved 19 young people (mean age 15.5, 9 males) diagnosed with internet or smartphone addiction and 19 gender- and age-matched healthy controls. Twelve of the addicted youth received nine weeks of cognitive behavioral therapy, modified from a cognitive therapy program for gaming addiction, as part of the study.

Researchers used standardized internet and smartphone addiction tests to measure the severity of internet addiction. Questions focused on the extent to which internet and smartphone use affects daily routines, social life, productivity, sleeping patterns and feelings.

“The higher the score, the more severe the addiction,” Dr. Seo said.

Dr. Seo reported that the addicted teenagers had significantly higher scores in depression, anxiety, insomnia severity and impulsivity.

The researchers performed MRS exams on the addicted youth prior to and following behavioral therapy and a single MRS study on the control patients to measure levels of gamma aminobutyric acid, or GABA, a neurotransmitter in the brain that inhibits or slows down brain signals, and glutamate-glutamine (Glx), a neurotransmitter that causes neurons to become more electrically excited. Previous studies have found GABA to be involved in vision and motor control and the regulation of various brain functions, including anxiety.

The results of the MRS revealed that, compared to the healthy controls, the ratio of GABA to Glx was significantly increased in the anterior cingulate cortex of smartphone- and internet-addicted youth prior to therapy.

Dr. Seo said the ratios of GABA to creatine and GABA to glutamate were significantly correlated to clinical scales of internet and smartphone addictions, depression and anxiety.

Having too much GABA can result in a number of side effects, including drowsiness and anxiety.

More study is needed to understand the clinical implications of the findings, but Dr. Seo believes that increased GABA in the anterior cingulate gyrus in internet and smartphone addiction may be related to the functional loss of integration and regulation of processing in the cognitive and emotional neural network.

The good news is GABA to Glx ratios in the addicted youth significantly decreased or normalized after cognitive behavioral therapy.

“The increased GABA levels and disrupted balance between GABA and glutamate in the anterior cingulate cortex may contribute to our understanding the pathophysiology of and treatment for addictions,” Dr. Seo said.

Co-authors are Eun-Kee Jeong, Ph.D., Sungwon Choi, Yunna Kwon, Hae-Jeong Park, and InSeong Kim.

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Neurofeedback Shows Promise in Treating Tinnitus

AT A GLANCE

- **Researchers are studying a novel approach to treat tinnitus, or “ringing in the ear.”**
- **Using fMRI and neurofeedback, the researchers were able to train people to decrease brain activity in response to white noise.**
- **Tinnitus is a common ailment, affecting one in five people.**

CHICAGO – Researchers using functional MRI (fMRI) have found that neurofeedback training has the potential to reduce the severity of tinnitus or even eliminate it, according to a study presented today at the annual meeting of the Radiological Society of North America (RSNA).

Tinnitus is the perception of noise, often ringing, in the ear. The condition is very common, affecting approximately one in five people. As sufferers start to focus on it more, they become more frustrated and anxious, which in turn makes the noise seem worse. The primary auditory cortex, the part of the brain where auditory input is processed, has been implicated in tinnitus-related distress.

For the study, researchers looked at a novel potential way to treat tinnitus by having people use neurofeedback training to turn their focus away from the sounds in their ears. Neurofeedback is a way of training the brain by allowing an individual to view some type of external indicator of brain activity and attempt to exert control over it.

“The idea is that in people with tinnitus there is an over-attention drawn to the auditory cortex, making it more active than in a healthy person,” said Matthew S. Sherwood, Ph.D., research engineer and adjunct faculty in the Department of Biomedical, Industrial and Human Factors Engineering at Wright State University in Fairborn, Ohio. “Our hope is that tinnitus sufferers could use neurofeedback to divert attention away from their tinnitus and possibly make it go away.”

To determine the potential efficacy of this approach, the researchers had 18 healthy volunteers with normal hearing undergo five fMRI-neurofeedback training sessions. Study participants were given earplugs through which white noise could be introduced for periods of time. The earplugs also served to block out the scanner noise.

To obtain fMRI results, the researchers used single-shot echoplanar imaging, an MRI technique that is sensitive to blood oxygen levels, providing an indirect measure of brain activity.

“We started with alternating periods of sound and no sound in order to create a map of the brain and find areas that produced the highest activity during the sound phase,” Dr. Sherwood said. “Then we selected the voxels that were heavily activated when sound was being played.”

The participants then participated in the fMRI-neurofeedback training phase while inside the MRI scanner. They received white noise through their earplugs and were able to view the activity in their primary auditory cortex as a bar on a screen. Each fMRI-neurofeedback training run contained eight blocks separated into a 30-second “relax”

period followed by a 30-second “lower” period. Participants were instructed to watch the bar during the relax period and actively attempt to lower it by decreasing primary auditory cortex activity during the lower phase.

The researchers gave the participants techniques to help them do this, such as trying to divert attention from sound to other sensations like touch and sight.

“Many focused on breathing because it gave them a feeling of control,” Dr. Sherwood said. “By diverting their attention away from sound, the participants’ auditory cortex activity went down, and the signal we were measuring also went down.”

A control group of nine individuals were provided sham neurofeedback — they performed the same tasks as the other group, but the feedback came not from them but from a random participant. By performing the exact same procedures with both groups using either real or sham neurofeedback, the researchers were able to distinguish the effect of real neurofeedback on control of the primary auditory cortex.

The study represents the first time fMRI-neurofeedback training has been applied to demonstrate that there is a significant relationship between control of the primary auditory cortex and attentional processes. This is important to therapeutic development, Sherwood said, as the neural mechanisms of tinnitus are unknown but likely related to attention.

The results represent a promising avenue of research that could lead to improvements in other areas of health like pain management, according to Dr. Sherwood.

“Ultimately, we’d like take what we learned from MRI and develop a neurofeedback program that doesn’t require MRI to use, such as an app or home-based therapy that could apply to tinnitus and other conditions,” he said.

Co-authors are Emily E. Diller, M.S., Subhashini Ganapathy, Ph.D., Jeremy Nelson, Ph.D., and Jason G. Parker, Ph.D.

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Male Triathletes May Be Putting Their Heart Health at Risk

AT A GLANCE

- **Male triathletes who log too much distance may be at risk for myocardial fibrosis of the left ventricle.**
- **Myocardial fibrosis, or scarring of the heart, might lead to heart failure.**
- **Evidence of myocardial fibrosis was seen in 18 percent of male triathletes studied, but none of the female triathletes.**

CHICAGO – Competitive male triathletes face a higher risk of a potentially harmful heart condition called myocardial fibrosis, according to research being presented next week at the annual meeting of the Radiological Society of North America (RSNA). The increased risk, which was not evident in female triathletes, was directly associated with the athletes' amount of exercise.

Myocardial fibrosis is scarring of the heart. It usually affects the pumping chambers, also known as the ventricles. The condition might progress to heart failure. While regular exercise has beneficial effects on the cardiovascular system, previous studies have shown the presence of myocardial fibrosis in elite athletes.

“The clinical relevance of these scars is currently unclear,” said study lead author Jitka Starekova, M.D., fellow in the Department for Diagnostic and Interventional Radiology and Nuclear

Medicine at University Medical Center Hamburg-Eppendorf in Hamburg, Germany. “However, they might be a foundation for future heart failure and arrhythmia.”

Dr. Starekova and colleagues recently studied a group of triathletes, including 55 men, average age 44, and 30 women, average age 43. The study group underwent cardiac MRI exams with the contrast agent gadolinium, which is taken up by both normal and injured heart muscle tissue. Gadolinium washes out quickly in normal heart tissue, but much more slowly in scarred tissue, revealing a difference in contrast between normal and injured heart muscle after approximately 10 minutes. This phenomenon, known as late gadolinium enhancement, is a useful tool for detection of myocardial fibrosis.

Evidence of myocardial fibrosis was apparent in the left ventricle — the heart's main pumping chamber — in 10 of 55 of the men, or 18 percent, but in none of the women.

These same athletes had completed significantly longer total, swimming and cycling distances and had higher peak exercise systolic blood pressure than their counterparts without myocardial fibrosis.

Lifetime competition history for the athletes showed that the number of completed Iron Man triathlons and the number of middle distance triathlons were significantly higher in the male triathlete population compared to the female triathlete population, suggesting that the fibrosis risk was likely associated with exercise level.

“Comparison of the exercise test results revealed that female triathletes had lower systolic blood pressure at peak exercise and achieved lower maximal power compared to male triathletes,” Dr. Starekova noted. “Furthermore, comparison of the sport history showed that females had a tendency to complete shorter distances compared to

male triathletes. This supports the concept that blood pressure and race distances could have an impact on formation of myocardial fibrosis.”

There are several possible factors for the link between the amount of exercise and the risk of myocardial fibrosis, according to Dr. Starekova. Higher exercise-induced systolic blood pressure may result in greater myocardial mass, she said, and more exercise might expose the athlete to a higher risk of myocarditis, or inflammation of the heart muscle. These factors, in combination with repeatedly increased stress of the left ventricular wall due to exercise, could injure the heart muscle.

Other factors may be responsible for the striking difference in myocardial fibrosis risk between male and female triathletes, Dr. Starekova said, including the presence of testosterone.

“Although we cannot prove the exact mechanism for the development of myocardial fibrosis in triathletes, increased systolic blood pressure during exercise, the amount and extent of race distances and unnoticed myocarditis could be cofactors in the genesis of the condition,” she said. “In other words, repetition of any extreme athletic activity may not be beneficial for everyone.”

The researchers plan long-term follow-up studies to see if any cardiac events occur in the triathletes who had evidence of myocardial fibrosis.

Co-authors are Enver Tahir, M.D., Kai Muellerleile, M.D., Alexandra von Stritzky, M.D., Julia Muench, M.D., Maxim Avanesov, M.D., Julius Weinrich, M.D., Christian Stehning, Sebastian Bohnen, M.D., Ulf K. Radunski, M.D., Eric Freiwald, M.D., Stefan Blankenberg, M.D., Gerhard Adam, M.D., Axel Pressler, M.D., Monica Patten, M.D., and Gunnar K. Lund, M.D.

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Overweight Women May Need More Frequent Mammograms

AT A GLANCE

- **Women who are overweight may need to be screened for breast cancer more frequently.**
- **The study found that cancers detected within two years of a normal mammogram were larger in women with high BMI.**
- **Among women with interval cancers, women with higher BMI also had a worse prognosis than women with lower BMI.**

CHICAGO – Women with higher body mass index (BMI) face an increased risk of not detecting their breast tumor until it has become large, according to a new study being presented next week at the annual meeting of the Radiological Society of North America (RSNA). Researchers said the findings suggest that women with higher BMI may need shorter intervals between mammography screening exams.

BMI is a measure of body fat based on height and weight, with overweight defined as a BMI of 25 or more. High BMI is associated with a number of health risks, including diabetes and heart disease. However, BMI is not considered as part of breast cancer screening guidelines.

For the new study, conducted at Karolinska Institutet in Sweden, researchers set out to identify risk factors associated with tumors not being detected until larger than 2 centimeters (cm), or about the size of a peanut, and to examine the implications for long-term prognosis. The 2-cm size is important because it is one of the parameters used to separate stage I and stage II cancers. In addition, tumor size is known to be strongly associated with prognosis, according to study co-author Fredrik Strand, M.D., radiologist at the Karolinska University Hospital in Stockholm, Sweden.

Dr. Strand and colleagues studied 2,012 cases of invasive breast cancer that appeared from 2001 to 2008. The researchers followed the patients until the end of 2015, and looked for how disease progression was related to BMI and breast density.

For cancers detected at screening, both BMI and breast density were associated with having a large tumor at diagnosis. However, for interval cancers, or cancers detected within two years of a normal mammogram, only BMI was linked with having a large tumor. Women with higher BMI had worse prognosis than women with lower BMI among interval cancers. Breast density showed no significant association with disease progression.

Dr. Strand said the findings provide more information for physicians and patients when deciding about optimal screening approaches.

“Our study suggests that when a clinician presents the pros and cons of breast cancer screening to the patient, having high BMI should be an important ‘pro’ argument,” he said. “In addition, our findings suggest that women with high BMI should consider shorter time intervals between screenings.”

Besides the larger interval cancers, women with high BMI may have other factors that put them at risk for a worse prognosis, including the molecular composition of the tumors and hormone receptor expression levels that make them harder to treat, Dr. Strand added.

The study was carried out in Sweden, which has 18- to 24-month intervals between screenings — longer than the 12 months recommended by some U.S. organizations like the American Cancer Society, but not the 24-month screening interval recommended by the United States Preventive Services Task Force (USPSTF). In addition, there are fewer women with high BMI in Sweden than in the U.S.

In the near future, Dr. Strand intends to look at how breast density is associated with delayed detection. Longer-term, he wants to study artificial intelligence as a way to triage mammographic screening examinations into different pipelines based on the risk of breast cancer and the detectability of a potential tumor.

Co-authors are Keith Humphreys, Ph.D., Johanna Holm, M.Sc., Mikael Eriksson, M.Sc., Sven Törnberg, M.D., Ph.D., Per Hall, M.D., Ph.D., Edward Azavedo, M.D., Ph.D., and Kamila Czene, Ph.D.

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MRI Uncovers Brain Abnormalities in People with Depression and Anxiety

AT A GLANCE

- **MRI shows structural similarities and differences in the brains of people with depression and social anxiety.**
- **Many of these individuals show changes to the cortex.**
- **MDD and SAD patients show common gray matter abnormalities in brain networks that govern attention.**

CHICAGO – Researchers using MRI have discovered a common pattern of structural abnormalities in the brains of people with depression and social anxiety, according to a study presented being next week at the annual meeting of the Radiological Society of North America (RSNA).

Major depressive disorder (MDD), often simply referred to as depression, is a serious condition. The condition can have a debilitating effect on an individual's life. People with MDD often lose interest in activities they once enjoyed and sometimes find it difficult just to get out of bed. At times, they may feel suicidal. About 16 million Americans have MDD.

Social anxiety disorder, or SAD, is an intense fear of being watched and judged by others. Symptoms can be extreme enough to interfere with daily activities. People with this disorder have difficulty developing and maintaining social and romantic relationships. About 15 million American adults have social anxiety disorder.

Both conditions share some clinical symptoms, suggesting the two disorders may have similar brain mechanisms. However, few studies have directly compared the brain structural effects of the two disorders, said the author of the new study, Youjin Zhao M.D., Ph.D., from Sichuan University in Chengdu, China.

Dr. Zhao and co-author Su Lui, M.D., used MRI to assess alterations in the brain's gray matter among MDD and SAD patients. They focused on the thickness of the cortex, which is the outer layer of the cerebrum, or principal part of the brain.

The researchers acquired and analyzed high-resolution images from 37 MDD patients, 24 SAD patients and 41 healthy control individuals. Both MDD and SAD patients, relative to healthy controls, showed gray matter abnormalities in the brain's salience and dorsal attention networks. The salience network is a collection of brain regions that determine which stimuli are deserving of our attention, while the dorsal attention network plays an important role in focus and attentiveness.

“Our findings provide preliminary evidence of common and specific gray matter changes in MDD and SAD patients,” Dr. Zhao said. “Future studies with larger sample sizes combined with machine learning analysis may further aid the diagnostic and prognostic value of structural MRI.”

The differences between the MDD and SAD patients and the healthy controls related to either thickening or thinning of the cortex. For instance, both MDD and SAD patients, relative to healthy controls, showed cortical thickening in the insular cortex, a brain region vital to perception and self-awareness.

It is still unclear exactly what the relationship is between the clinical manifestations of MDD and SAD and cortical thickening in brain regions like the anterior cingulate cortex, a part of the brain associated with emotion, Dr. Zhao said.

“First, it is possible that a greater cortical thickness may reflect a compensatory mechanism that is related to inflammation or other aspects of the pathophysiology,” she said. “Second, greater anterior cingulate cortical thickness could be the result of both the continuous coping efforts and emotion regulation attempts of MDD and SAD patients.”

As for cortical thinning, Dr. Zhao said that other research provides convincing evidence to support the theory that reduced cortical layer thickness in some brain regions may result in the decreased thickness of the frontal lobe, a large part of the brain that is involved in variety of functions, including emotion.

The researchers also found disorder-specific involvement of the brain’s “fear circuitry” in patients with SAD and involvement of the visual recognition network in patients with MDD. Alterations in the brain within the region of the visual recognition network might be related to impaired selective attention and working memory in MDD, Dr. Zhao indicated.

“The visual recognition network is involved in emotional facial processing, which is crucial for social functioning,” she said. “Depression has been associated with structural alterations in these regions.”

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